

RESEARCH ARTICLE

On the importance of citizen-science: first records of the Giant water bug *Lethocerus patruelis* (Hemiptera, Belostomatidae) in Cyprus

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Abstract

Citizen science has gradually become an important source of data for science. In the present work, we further corroborate this notion by confirming the presence of the Giant water bug, *Lethocerus patruelis* on the island of Cyprus, based on citizen findings. Our records rely almost entirely on information initially provided through social networks by biodiversity-enthusiast users. We investigate the likely origin of *L. patruelis* in Cyprus and discuss the possibility of an established population of the species on the island. We also outline some initial thoughts on the environmental impact of a possible future establishment on the islands' water bodies.

Keywords

Mediterranean, distribution, migration, social networks.

Introduction

Representatives of the genus *Lethocerus* Mayr 1853 (Hemiptera: Heteroptera: Nepomorpha: Belostomatidae), also called "Giant water bugs" or "Electric light bugs", include the largest Heteroptera, as the body length of many species can exceed 12

centimeters (Davranoglou and Karaouzas 2021; Schuh and Slater 1995). With their large size and predatory lifestyle, Belostomatids prey on a variety of organisms such as invertebrates, fish, turtles, and even birds (Matheson 1907; Ribeiro et al. 2018). Species determination within the genus requires high expertise and the use of a stereoscope in order to investigate interspecies morphological differences. *Lethocerus* species deposit their eggs on vegetation near the water and the males take care of the eggs (Lauck and Menke 1961). This exclusive male parental investment as expressed in Belostomatinae is a rare behavior among animals.

Until now, no member of Belostomatidae has ever been recorded on the island of Cyprus, despite the extensive samplings of aquatic invertebrates in most waterbodies of the island, that have been taking place for over a decade by the Water Development Department of the Republic of Cyprus. In neighboring mainland countries (Turkey, Israel, Lebanon, and Egypt) two species of *Lethocerus* are present, *L. patruelis* (Stål 1854) and *L. cordofanus* Mayr 1853.

The species *L. patruelis* has an Indo-Mediterranean distribution and it is the only representative of the family in Europe. It is found across Europe, the Arabian Peninsula and the Indian subcontinent (Perez Goodwyn 2006; Dulčić et al. 2015; Davranoglou and Karaouzas 2021).

The second species, *L. cordofanus* is a predominantly African species and it is present across central tropical Africa south of the Sahara Desert from the Gulf of Guinea to Somalia. The southernmost locality where it has been recorded in Pretoria of South Africa. In the north, *L. cordofanus* reaches the Mediterranean through the Nile river basin (Perez Goodwyn 2006) and it has also been recorded in Israel (Novoselsky et al. 2018).

In this study, we provide the first records of the Giant water bug *Lethocerus patruelis* in Cyprus. These findings provide evidence of the species dispersion to new areas within the Mediterranean basin, following its verified presence in Italy, the Balkan Peninsula, Greece (including the island of Rhodes in eastern Greece as reported by Corsini-Foka et al. 2019), European Turkey and Israel. Dispersion of the species in new locations within the same climatic zone, could in the future lead to the establishment of populations in Cyprus (also taking into account that individuals were recorded in two consecutive years), provided that suitable habitats are available.

The records reported in this study were based almost entirely on people who posted photographs and videos on social media groups requesting species determination. When possible, the specimens were subsequently collected and studied in detail by the authors.

Materials and methods

The presence of a Giant water bug in Cyprus was initially noticed in the Facebook group (FBG) “Biodiversity of Cyprus”, a group that focuses on the fauna and flora of Cyprus. A video posted in the group on May 20th 2021 presented a Giant water bug

crawling on sandy substrate in Bedis Beach, Salamina. As there were no records of this insect family in Cyprus we contacted the person who posted the video for further information. The next day a photo of a dead specimen was posted in the FBG “Kıbrıs Yaban Hayatı (Cyprus Wildlife)” from the same location (Bedis Beach). We tried to locate and acquire that specimen but without success.

Another record was spotted from a photograph posted in the FBG Biodiversity of Cyprus from Vrysoudia locality in Paralimni. It was a specimen that landed on a hotel balcony, on the 6th floor. After immediate communication with the individual who posted the photo, the specimen was safely collected and delivered to the authors. The hotel owner also claimed that an insect of similar appearance and size was found the previous year on the lawn by the hotel pool.

We thereafter searched through all posts in the last 5 years, in five different Facebook Groups related to the nature of Cyprus: Biodiversity of Cyprus; Cyprus Wildlife - Kıbrıs Yaban Hayatı; Arthropods of Cyprus; Insects of Greece & Cyprus and Cyprus insects. We also searched in other online observation platforms (i.e. iNaturalist) to locate any available records that might have been overlooked in the past, but this effort did not yield any results.

Additionally, we conducted field investigations in water bodies close to the locations where the species was recorded, in an attempt to find additional specimens and confirm the presence of the Giant water bug in inland waters. It must be noted that despite our extensive collective efforts in freshwater habitats throughout the island, the species had never been previously recorded.

The collected specimens were identified by examining the foretarsus, the prosternal keel and the genital plate based on the works of Perez Goodwyn (2006) and Novoselsky et al. (2018). Diagnostic morphological characteristics of the examined specimens are shown in Figure 3.

Results

A total of seven sightings were eventually recorded, five from social media, and two after communications between local naturalists and the authors team. The locations of the specimens of *L. patruelis* records are presented in Figure 1. All records were located on the eastern lowland part of the island and mainly along the eastern shoreline. Out of the seven records, we managed to acquire two individuals for a thorough morphological examination. These individuals were identified as *Lethocerus patruelis* (Stål, 1855). For the remaining records, which were not collected, it was not possible to verify the exact *Lethocerus* species from the available pictures. Therefore, even though *L. patruelis* is the only confirmed taxon of the Belostomatidae family reported in Europe, we treated photographic records as *Lethocerus* sp.

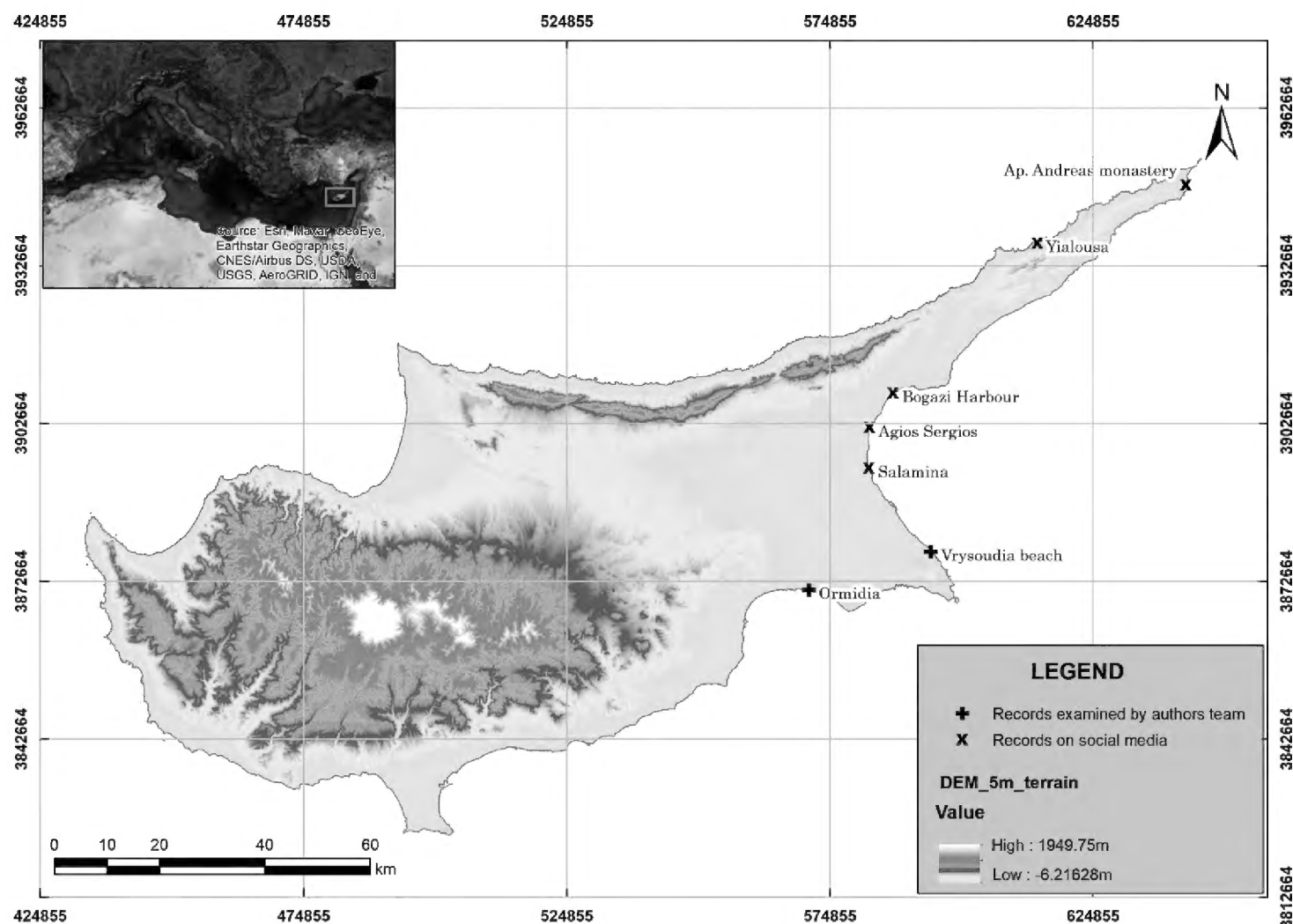


Figure 1. Locations of the reported Giant water bug *Lethocerus sp.* sightings, in Cyprus. Map created using ArcMap release 10.3.1.

Material examined:

Abbreviations: PC = Personal communication; FBG= Facebook group.

Lethocerus patruelis (Stål, 1855)

Famagusta District: Paralimni, Hotel at Vrysoudia Beach; 1♀, 19.VI.2021, specimen landed on the balcony of a hotel room, FBG Biodiversity of Cyprus, 35° 2'35.13"N, 34° 1'53.68"E, leg. Loucas Petrou and Maria Hadjicharalambous;

Larnaka District: Ormidia, 1♀, 3.VIII.2021, a specimen found dead on the beach, PC, 34°58'49.64"N, 33°46'35.45"E, leg. Roger White

The examined specimens were deposited in the personal collections of Michael Hadjiconstantis and Marios Aristophanous, respectively.

Records from social media:

Lethocerus sp.

Famagusta District: Apostolos Andreas Monastery, 1 individual, 17.V.2020, specimen walking on a rocky beach, FBG Kıbrıs Yaban Hayatı, 35°39'44.29"N, 34°34'24.20"E, leg. Faik Cemmedo;

Famagusta District: Agios Sergios, 1 individual, 20.VIII.2020, specimen walking on the beach, FBG Kıbrıs Yaban Hayatı, 35°14'22.74"N, 33°54'10.22"E, leg. Aysun Kurt

Famagusta District: Salamina, beach near Salamis ancient city (Bedis Beach), 1 individual, 20.V.2021, specimen walking on the beach, FBG Biodiversity of Cyprus, 35°11'15.40"N, 33°54'14.05"E, leg. Hasan Deniz Akbora;

Famagusta District: Yialousa, 1 individual, 12.VIII.2020, specimen swimming in the sea, PC, 35°34'11.65"N, 34°15'39.38"E, photo of an anonymous observer;

Famagusta District: Bogazi Harbour, 1 individual, 7.V.2021, specimen walking near the harbour, FBG Kıbrıs Yaban Hayatı, 35°18'47.65"N, 33°57'9.93"E.

The original photographic records from social media are shown in Figure 2.

Discussion

Giant water bugs are large insects, hard to be overlooked by scientists or nature enthusiasts. With this in mind, we assume that the chance of the Giant water bug being present in Cyprus before the reported records (i.e. before 2020) is rather unlikely, as previous studies on the insect fauna of Cyprus did not report this species

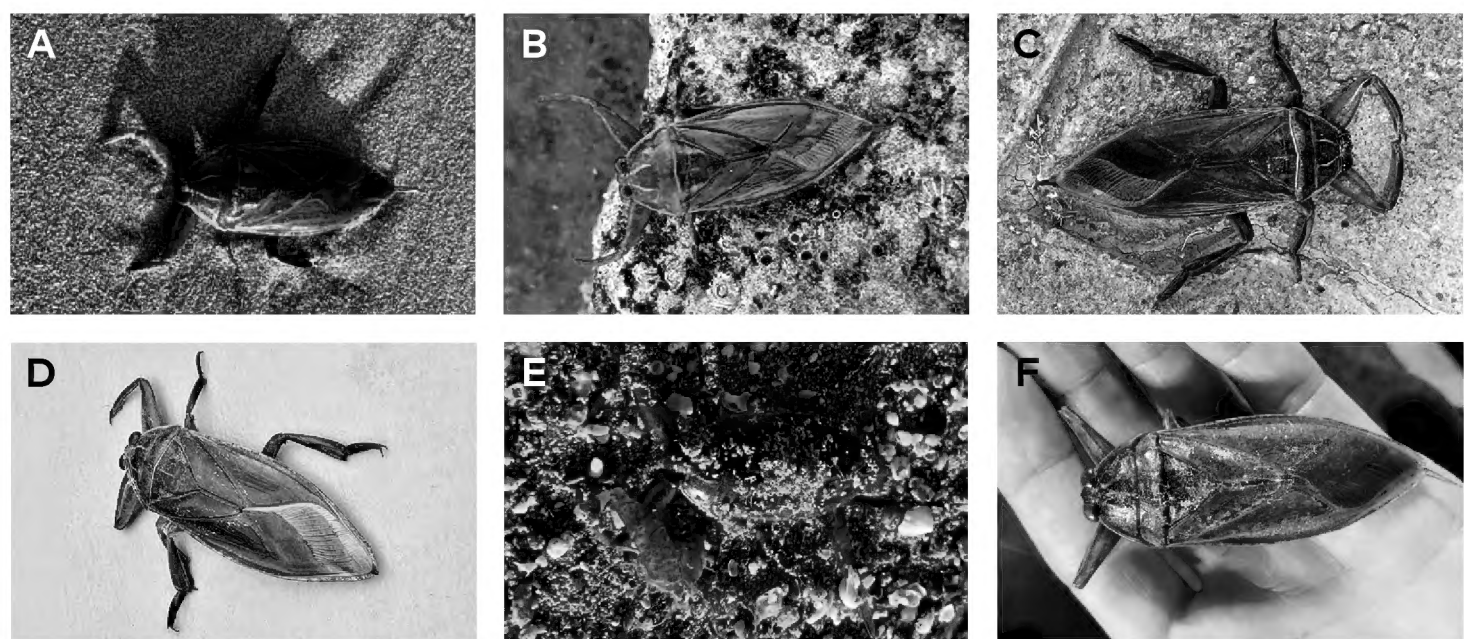


Figure 2. Photographs of *Lethocerus sp.* in situ: **A** Agios Sergios; **B** Apostolos Andreas Monastery; **C** Bogazi Harbour; **D** Paralimni; **E** Salamina; **F** Ormideia. Records from Facebook Groups (FBG) and Personal Communication (PC).

(Georghiou 1977; Lindberg 1948; Villastrigo et al. 2017). All records were located in coastal areas in the eastern part of Cyprus, and consisted of dead or moribund specimens, as they soon died after being captured. This indicates that they probably flew to Cyprus from the neighboring mainland. The reasons behind this dispersal of several individuals are unknown and need to be further investigated; Corsini-Foka et al. (2019) suggested that a possible reason for such translocation is their attraction to lights near the coasts of the island. In addition, Cianferoni and Nardi (2013) also refer to the observation of flying individuals attracted by ship lights. It is worth mentioning that in the last decades, there was intense development and an increase in shipping activities in the eastern coastal areas of the island. The specimens landed exhausted on the shoreline, or in some cases in the sea, which could indicate that they were transferred by wind or sea currents from nearby countries. This hypothesis has also been made by Davranoglou and Karaouzas (2021). The dispersal of *L. patruelis* in Cyprus could have also been driven by other factors such as the search for food, as in the cases of other *Lethocerus* species, that migrate when the food supply in their habitat becomes unsuitable (Ohba & Takagi 2005). The recorded individuals were collected or observed from the eastern part of the island (Famagusta and Larnaca districts), in proximity to Israel, Lebanon and Syria where *L. patruelis* occurs (e.g.

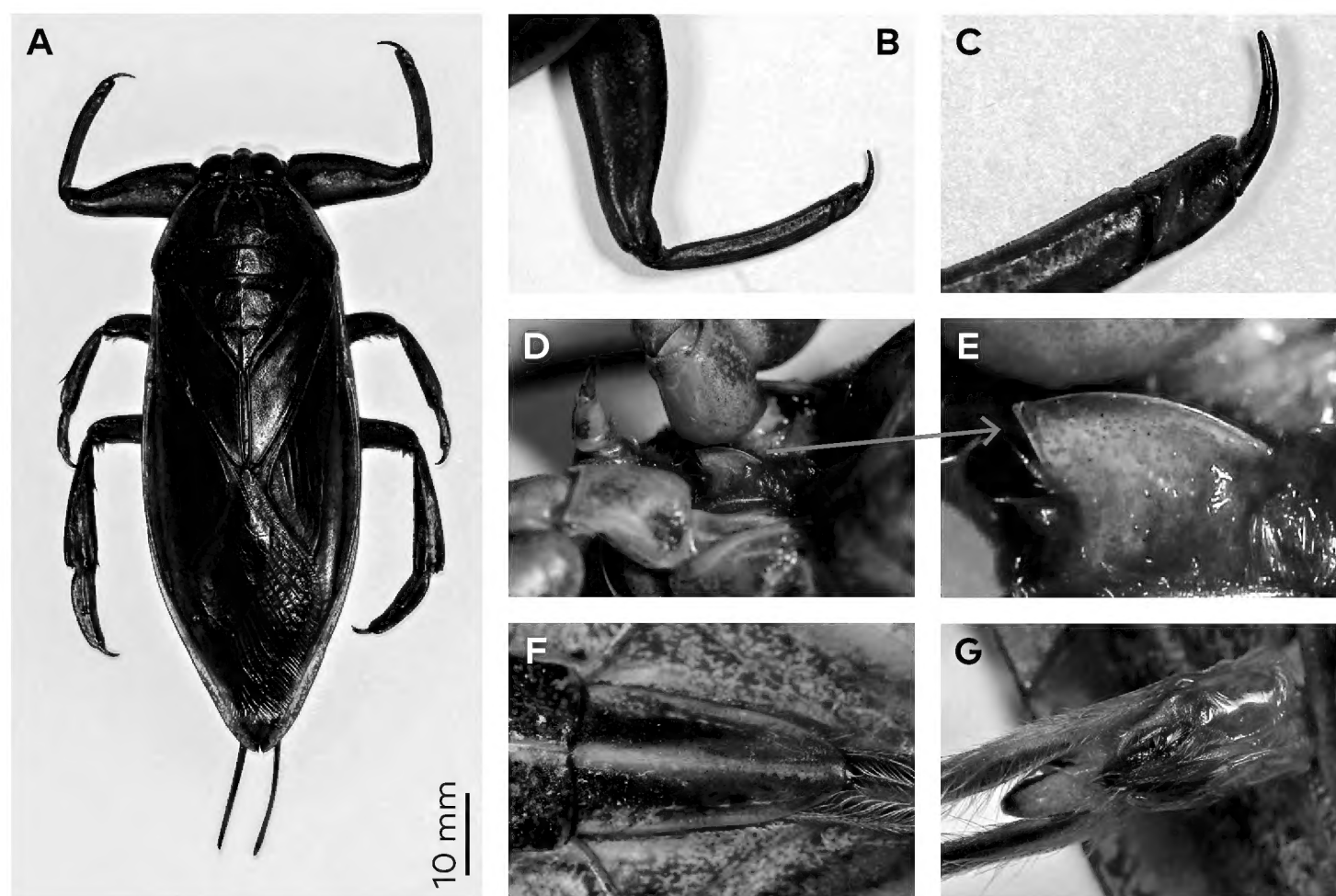


Figure 2. Morphological parts and taxonomic characteristics were used for the identification of the two examined *Lethocerus patruelis* specimens: **A** *Lethocerus patruelis* specimen from Paralimni; **B–G** Morphological parts of the same specimen; **B, C** foretarsus; **D, E** Prosternum medially (red arrow indicates prosternal keel); **F** genital plate (operculum); **G** female genitalia (genital capsule).

111 km from Apostolos Andreas Monastery, Cyprus, to Latakia Port, Syria). Thus, a migration event from neighboring countries on the Levantine coast cannot be rejected, taking into account that the specimens were reported in two consecutive years. The possibility of the species arriving in Cyprus due to human activities (e.g. import of traded goods) is not considered, as all records were in coastal areas and no individuals were found inland.

At the time of writing, no individual of the species was found in other nearby inland water bodies; therefore, we assume that *L. patruelis* has not yet been established in Cyprus. It is possible that the arrival of a non-negligible number of individuals on the island in such a short timeframe could portend a future establishment of viable populations on the island. It is worth mentioning that the two examined specimens were females and the possibility of male presence in unexamined records cannot be excluded.

Although *L. patruelis* is not native to Cyprus, in the likely case of its establishment on the island, the chance of causing adverse impacts on the native fauna of the island is considered limited. The fauna and habitats of the island are similar to those in *L. patruelis* natural range. In addition, some of its natural predators, such as the white stork (*Ciconia ciconia*) and black kite (*Milvus migrans*) mentioned in Davranoglou and Karaouzas (2021) and a variety of other inland predators, are either migratory visitors or permanently present on the island. This could ensure the biological control of a possible established population. In light of the above, more research about the origin of the specimens found, the causes of migration and the possibility of species establishment is underway, and any updates will be reported in future work.

The recording of *L. patruelis* in Cyprus proves once more the valuable contribution of unconventional sources of data, such as social networks and citizen science to species documentation and biodiversity monitoring. There are numerous cases where social media have played an important role in providing data to scientists related but not restricted to biodiversity, alien and invasive species, terrestrial and aquatic habitats (Christou et al. 2023; Davranoglou and Karaouzas 2021; John et al. 2023; Bariche et al. 2020; Faraone et al. 2017; Hadjiconstantis and Zoumides 2021; Katsanevakis et al. 2020; Kazilas et al. 2021; Kleitou et al. 2019). Moreover, social networks can help in providing data at a low cost (Chamberlain 2018). Therefore, if treaded correctly, data from social networks and other online sources can provide additional valuable information for several taxa. In addition, if citizen science is guided by researchers to achieve a more uniform and systematic search effort, the quality of data can be considerably improved.

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